NASA-CR-193537

The Johns Hopkins University

Applied Physics Laboratory
Laurel, Maryland

GRANT

IN-89-CR

177628

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Final Technical Report

NASA Grant NAGW-522

Completion Date: 04/30/90 Report Date: 11/30/90

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The objective of work under this grant was to develop ultra-narrow optical passband filters and other technology necessary for construction of a compact solar telescope capable of operating unattended in space for long periods. The scientific problems to which such a telescope could be applied include solar seismology, solar activity monitoring, solar irradiance variations, and solar magnetic field evolution.

Progress under the grant before 1987 was reported in the Johns Hopkins APL Technical Digest, Vol. 7. A copy of the report appears in Appendix A. Since that report, two instruments based on the technology described there have been built and operated at U. S. observatories.

In early 1989, one version of the basic instrument was installed at the Mount Wilson Observatory in California. It is called the Stable Solar Analyzer (SSA) because its principal objective is to measure the oscillatory motion of the solar surface. Because the oscillations are very long-lived, their frequency spectra must be studied with a very stable instrument. The SSA uses an electrically-tunable lithium niobate Fabry-Perot etalon and a solid-state laser to achieve high wavelength stability. Personnel from APL and the University of Southern California used the SSA to obtain almost daily solar oscillation data at Mt. Wilson. The observations showed that the tunable solid Fabry-Perot etalon used in the SSA and in the solar vector magnetograph later installed at the National Solar Observatory is suitable for space missions that call for measurements with ultra-narrow tunable bandpass filters.

Earlier progress in the instrumentation program and the results of a six-day observing run at the National Solar Observatory were reported at the IAU Symposium on Advances in Helio-and Asteroseismology in July, 1986 (Rust *et al.*, 1986; Hill *et al.*, 1986). These data provided evidence that the interior equatorial solar rotation rate decreases with depth between 15,000 and 60,000 km below the photosphere of the sun.

In 1987 - 88 most of our efforts in this program were directed toward strengthening a proposal (Rust *et al.*, 1987) to put an SSA on the NASA/ESA SOHO mission. These efforts included laboratory tests of the optical components and design of an on-board data handling system. The SSA proposal was highly rated but was not selected for the mission.

In February, 1989, the optical components and analog electronics of the ground-based version of the SSA were installed in the 60-foot tower at the Mount Wilson Observatory. Between then and late 1989 regular solar observations were obtained with a 1024 x1024 CCD camera and digital computer already there. The quality of the observations was marginal until an improved blocker filter was installed. Also, the mechanical shutter was replaced with a liquid-crystal device. Also, the fine guider was put into full operation, allowing multiple images to be added in the computer before writing to tape.

At Mt. Wilson the JPL-supplied CCD required several seconds to record and store each image. This seriously degraded the quality of the data. In late 1989 and early 1990, we operated a commercial television camera with a frame grabber and recorded at 30 images per second. The frame grabber was successfully interfaced with an IBM PC/AT which also controls the SSA electo-optics and records engineering data.

E. Rhodes of the University of Southern California provided the observers, under another NASA grant, to operate the SSA and was leading the effort to evaluate the SSA power spectra when the present grant ended. All the equipment has now been returned to APL.

Development of the SSA and the fine guider was a significant achievement. The guider, the Fabry-Perot filter and the stable laser together constitute the major optical elements necessary for a space-borne instrument. The necessary computer capabilities were developed at APL with in-house funds. Altogether, work under the grant produced important technical innovations and led to a proposed major space experiment.

Publications resulting from work under the grant are listed in Appendix B.